March 31, 1936. V. W. MOODY 2,035,755

REFRIGERATION CONTROL MEANS

Filed Nov. 30, 1934

Fig. 1

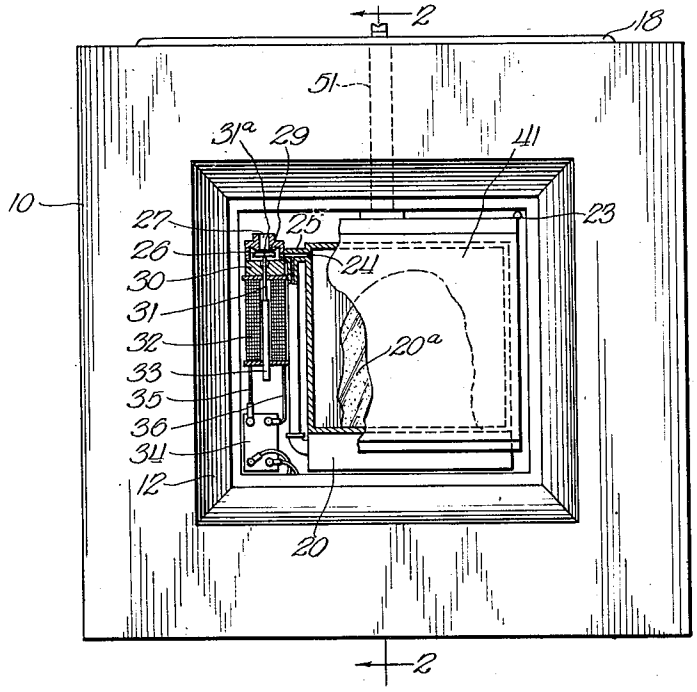
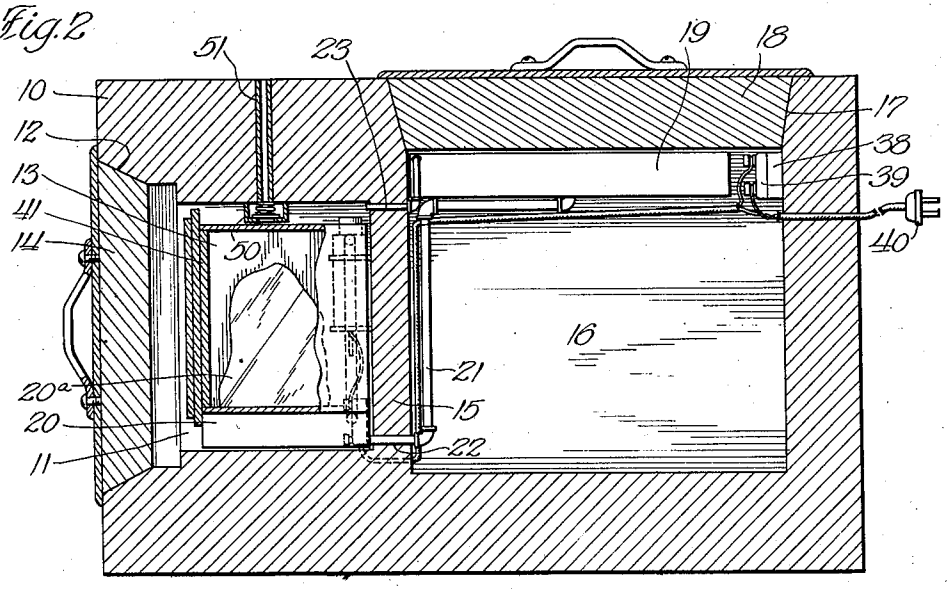


Fig. 2



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REFRIGERATION CONTROL MEANS

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16 Claims. (Cl. 62—91.5)

The present invention has to do with a refrigerating system and relates particularly to a means and mechanism for circulating a heat transferring liquid between compartments at predetermined regulated intervals of time.

The present invention has similarities to an apparatus illustrated in an application for Letters Patent in the name of Virginius W. Moody, Serial Number 677,006, filed June 22, 1933, issued as Patent No. 2,001,105, May 14, 1935, and entitled Refrigerator and temperature control device, and is a continuation in part of an application of the same Virginius W. Moody, Serial Number 701,789, entitled Refrigeration control means, and filed December 11, 1933.

The objects of the present invention include, among others, the provision of the following:

A circulatory system for a refrigerating apparatus causing a liquid for transmitting heat to ebb and to flow between one part of the system and another part thereof in a regulated manner;

A refrigerating system motivating a heat transferring liquid to circulate within a space to be refrigerated at periods of predetermined frequency, and to continue to circulate until the temperature of such space has been reduced to a predetermined degree;

A refrigerating device energized by a sublimable refrigerant and in which the gas obtained by the sublimation of the refrigerant effects a periodic shifting movement of a liquid heat conducting medium; and

A self-operating refrigerating device of the type in which there is a periodic circulation of a heat transferring liquid possessing a simplified and improved structure.

These, and such other objects as may hereinafter appear, are obtained by the novel construction, unique arrangement, and improved combination of the several elements that constitute the invention, one form of which is illustrated somewhat schematically in the accompanying single sheet of drawings, hereby made a part of this specification, and in which:

Figure 1 is a front elevation of a two compartment refrigerating device embodying the subject matter of the present invention, a front cover member that is employed therein being removed; and

Figure 2 is a vertical section of the device illustrated in Figure 1 taken on the lines 2—2 thereof.

Like reference characters are used in the drawing and throughout the following description to designate similar parts of the illustrated apparatus.

The two figures in the drawing may be read conjointly. The entire apparatus is housed in a cabinet having walls of suitable insulating material and structure. The insulated cabinet 10 is divided into two compartments. One compartment 11 has an opening or door aperture 12 and encloses a refrigerant holding box 13. Box or container 13 is sealed by an air tight cover or member 41. The aperture in compartment 11 is closed by a cover member 14 of any suitable structure, but preferably of a character similar to the walls of cabinet 10.

Separated from compartment 11 by an insulating wall 15 is a second compartment 16 having a door or cover opening 17. Opening 17 is closed by a cover 18 of suitable construction, preferably like that of cabinet 10. Compartment 16 is used for the storage of food and the like that is to be refrigerated.

A reservoir or tank 19 for a heat transferring liquid is suitably disposed in the compartment 16, preferably in the upper part thereof.

At a lower level than reservoir 19 an in compartment 11 is a second tank or reservoir 20. Tank 20 generally is disposed upon or at the under side of the refrigerant containing chamber 13.

Tank 19 from time to time receives the selected heat transferring liquid. The heat transferring liquid may be a brine of calcium chloride or it may be any other suitable liquid. The brine or heat transfer liquid should be of such character that it will not freeze within the tank 20. To prevent freezing, insulation either by spacing the walls of the container 13 from the top wall of the tank 20 or by the use of insulated strips within the container 13, may be desirable.

The capacity of tank 19 is larger than that of tank 20 or, if preferred, tank 19 may be supplemented by a reservoir tank that is not shown, the extra capacity of tank 19 or the employment of such supplemental tank making it possible that the entire contents of tank 20 may be collected in tank 19 (or in tank 19 and its supplemental tank) without overflow.

The under side or lower wall of box 13 is of a suitable heat conducting material. The upper side or wall of tank 20 may be the under wall of container 13, or the tank 20 may have an upper wall in contact with or spaced from the under wall of box 13 as desired. The proximity of contact between the under wall of box 13 and the upper wall of tank 20, in part, determines the rate of heat transfer from a refrigerant 20a which is contained in the box 13 and the brine or heat transfer liquid in tank 20. The rate of heat

transfer may also be regulated by the physical characteristics of a single element comprising the lower wall of box 13 and the upper wall of tank 20. The character of the material in the two walls of elements 13 and 20, when two walls are used, also affects the rate of heat transfer. Usually box 13 and tank 20 are each of metal and such metal possesses a high heat conductivity. When desired, the two walls may be spaced apart to provide a limited amount of air insulation therebetween or insulating sheets may be disposed upon the upper face of the lower wall of the chamber 13 to support the refrigerant 20a to concurrently reduce the rate of heat transfer between the materials in box 13 and tank 20.

A conduit 21 that extends through an aperture 22 in the wall 15 provides always open communication between the tanks 19 and 20. Preferably conduit 21 is disposed in the bottom of the tank 19 to allow for complete drainage of the heat transfer liquid therefrom. The other end of conduit 21 may terminate in the bottom of tank 20. In any event, such terminal of conduit 21 should be adjacent the bottom of tank 20 in order that all of the heat transfer liquid or substantially all of such liquid, may be discharged from the tank 20 by way of the conduit 21 into the tank 19 when gas pressure applied to the upper surface of the heat transfer liquid contained in the tank 20 has reached a sufficient degree to lift such liquid to tank 19.

The upper tank 19 has a breather. The breather comprises a conduit 23. The mouth of conduit 23 is connected to the tank 19 in a plane above that which the heat transfer liquid may reach when forced into tank 19 from tank 20. Thus, breather 23 will be always open to the atmosphere which is above the liquid content of the tank 19. The other end of breather 23 opens into compartment 11 at the exterior of the box 13 therein, and preferably in a plane above the level of the tank 20.

Breather 23 is an escape for air which but for the presence of breather 23 would be entrapped in tank 19 as the heat transfer liquid is forced into said tank through conduit 21. Such air, chilled to a degree by the heat transfer liquid forced in the tank 19, escapes into chamber 11. Chamber 11 is chilled by container 13 and by tank 20 therein.

Compartment 11 has an escape or safety valve 50 which opens into a conduit 51 extending through one of the walls of the container or cabinet 10. As illustrated, conduit 51 extends through the top wall of the cabinet but conduit 51 may be disposed elsewhere if desired. The valve 50 shown is spring controlled. A relatively light pressure within the chamber 11 opens said valve. Opening of the valve allows excess air or gas to escape directly to the atmosphere surrounding box 10. The valve 50 effectively prevents the admission of atmospheric air to the cabinet 11 from the outside under any normal condition of device operation.

Compartment 13, preferably adjacent its top, opens into a conduit 24. A T-shaped head 25 is disposed in conduit 24. Conduit 24 has therein a valve member 26. An exhaust passage 27 extends from the valve 26. When valve 26 is closed, the course of gas generated in the container 13 is into the tank 20. When the valve 26 is open the gas in container 13 if under a pressure exceeding that of the atmosphere of compartment 11 will escape from the box 13 through the exhaust passage 27 and into the compartment 11. As previously indicated, if there is an excessive pressure of gas in compartment 11, such pressure will be reduced by the escape of such excess gas through the valve 50 and conduit 51.

The escape of exhaust gas from box 13 into compartment 11 is effective to reduce the temperature of the chamber 11. The low temperature thus obtained reduces the heat losses through the walls of the container 13 and of tank 20, which heat losses occur if chamber 11 contains a warm atmosphere.

Valve 26 has a valve seat 29 about the passage way 27. An apertured block 30 is disposed opposite to the valve seat 29. The aperture in block 30 is a bearing for a valve stem 31. The upper end of stem 31 has a head 31a. The head 31a is mounted for movement against seat 29. At the under side of the block 30 is a solenoid 32 which is effective to actuate an armature 33. The armature 33 is a weight upon the valve stem 31. Movement of armature 33 under the influence of solenoid 32 is upwardly, hence when solenoid 32 is energized, valve head 31a is against seat 29 closing valve 26. Armature 33 is at its lowermost position when solenoid 32 is unenergized. Valve 26, therefore, is open save when the solenoid 32 is energized.

Beneath the solenoid 32, as is shown schematically in Figure 1, is a cycle determinator 34. Determinator 34 is adapted to automatically open and to close an electric circuit that includes electrical conductors 35 and 36 leading to the solenoid 32. The cycle determinator 34 possesses the characteristic of breaking the circuit to the solenoid 32 at predetermined intervals and of closing the circuit after such circuit has been open for a predetermined period. The normal position of the cycle determinator closes the circuit to the solenoid 32. An open circuit to the solenoid is produced by the cycle determinator when it has been heated a predetermined period of time. After the cycle determinator 34 has opened the circuit, the cycle determinator cools. The rapidity of cooling of the cycle determinator may be regulated and hence the period that the cycle determinator 34 maintains the circuit to the solenoid 32 open is capable of regulation, and is predeterminately regulated for any specific cycle of operations.

A circuit including the conductors 35 and 36 extends from the cycle determinator 34 to a switch 38 which is disposed in a convenient position in compartment 16. A thermostatic element 39 in the chamber 16 is operatively connected to the switch 38. Energy for the electric circuit including the switch 38 and conductors 35 and 36 is obtained by connecting a standard electrical fixture 40 to any suitable outlet.

The operation of the device which has been described is substantially as follows.

The refrigerating apparatus at the outstart will be at room temperature. Brine or any other suitable heat transferring liquid is poured into the liquid circulating system. The volume of such liquid should be sufficient to fill or substantially fill the tank 20. The fixture 40 is inserted into a suitable outlet.

The cycle determinator at this time is in its normal or closed position. As the refrigerating device is at room temperature, the thermostatic element 39 will maintain the switch 38 closed. The circuit at the instant before electrical energy is tapped will be with the valve 26 open. Immediately energy is tapped, the valve 26 will close and the cycle determinator will begin to function.

The cycle determinator will maintain the circuit to the solenoid 32 closed for a predetermined period of time, and thereafter open such circuit for another predetermined period of time.

Refrigerant 20a will be inserted into compartment 13 and the compartment closed by its cover 41. Compartment 11 will be closed by its cover 14. Immediately, a heat transfer between the brine in tank 20 and the container 13 chilled by refrigerant 20a will begin. Such heat transfer, at the outstart, will cause a relatively rapid sublimation of the refrigerant 20a. Gas pressure will be built up in the container 13. The sublimate will fill the container 13 and impress itself upon the top surface of the heat transfer liquid in tank 20. The pressure of the sublimate will force the heat transfer liquid upwardly through the conduit 21 into the tank 19. The heat transfer liquid will flow upwardly into the tank 19 and remain in tank 19 so long as cycle determinator 34 maintains the circuit to the solenoid 32 closed. The air forced out of the tank 19 will collect in compartment 11. If the pressure in the compartment exceeds that of the atmosphere external to cabinet 10 and that of the spring in valve 50, the excess air and gas in compartment 11 will escape to the atmosphere by conduit 51.

When the cycle determinator has reached the end of its first cycle, it will open the circuit to the solenoid 32, and the armature 33 will drop, opening the valve 26. When the valve 26 opens, the confined gas in box 13, conduit 24, and tank 20 escapes into the chamber 11 by way of passage 27. The escape of such gas into compartment 11 generally opens the valve 50 and allows the escape of any excess gas through the conduit 51. The gas as it escapes by way of the conduit 24 and passage 27 cools the atmosphere in chamber 11 and thus reduces the heat losses from the walls of the container 13 and tank 20 into the atmosphere within the compartment 11.

Should the cycle determinator 34 maintain the valve 26 closed a sufficient time for a transfer of the entire contents of the tank 20 to the tank 19, the gas which is generated in the chamber 13 thereafter will flow through the tank 20 and conduit 21, bubbling through the brine contents of tank 19. Such gas will thus escape into the compartment 11 by way of the breather 23. Should the amount of such gas be sufficient to unseat the valve 50, such gas will escape to the atmosphere by way of conduit 51. No harm, therefore, may result from the cycle determinator being slow of operation.

The period during which the circuit to the solenoid 32 is open may be relatively brief. It may be sufficient only to allow complete escape of the charging gas by way of conduit 24 and passage 27 and the concurrent gravitational flow of the heat transfer liquid from tank 19 into tank 20. When the brine has again collected in tank 20, the cycle determinator 34 closes the circuit to the solenoid 32, energizing the armature 33 and closing the valve 26, whereupon the sublimate from the refrigerant is collected in box 13, expands into the conduit 24 to the tank 20, and forces the heat transfer liquid from the tank 20 and into the tank 19 to cool the chamber or compartment 16.

Escape of the pressure producing sublimate into the compartment 11 equalizes the pressure within the interior of the chamber container 13 and the compartment 11. This permits of a rapid downward flow of the heat transfer liquid from the tank 19 to the tank 20 even though the gas which has escaped into chamber 11 may be in the course of discharge through valve 50 and conduit 51, or may raise the pressure in compartment 11 above that of the outside atmosphere.

The opening and closing of the circuit by the cycle determinator 34 to the solenoid 32 continues until a temperature in the compartment 16 is reduced to predetermined level. The brine which flows from the tank 20 into the tank 19 is in heat transfer relationship with the atmosphere in the compartment 16. Such brine therefore cools the atmosphere within the compartment 16 and concurrently absorbs heat from any article that may be stored therewithin.

When the temperature in compartment 16 has reached the previously mentioned predetermined level the thermostatic element 39 becomes effective to open the switch 38. When switch 38 is opened, the circuit to the cycle determinator is broken and also to the solenoid 32. The opening of the switch 38 which de-energizes the solenoid 32 allows the armature 33 to drop, the drop of which opens the valve 26 and allows escape of all compressing sublimate from container 13 into compartment 11. The sublimate is then free to escape to the outside atmosphere if the pressure in compartment 11 is sufficient to unseat valve 50.

Immediately all brine flows down conduit 21 from tank 19 and into the tank 20 to remain in heat transfer relationship with the under side of compartment 13. Such heat transfer liquid is continuously chilled by the refrigerant 20a to make it ready for future use, the chilling continuing until and when the temperature of compartment 16 rises above a predetermined level. When such temperature rises, it affects the thermostatic element 39 which closes the switch 38 to again energize the cycle determinator 34 and armature 33 to cause the apparatus to function in the manner hereinabove described.

As the valve 26 is solenoid operated, it opens and closes with great rapidity. The closing movement of the valve is positive. The opening of the valve has the aid of the pressure in the tank container 13. The possibility or probability of having a partly closed valve thus is reduced to a minimum. No valves are employed within the brine circulating system, hence it is substantially impossible for any portion of the apparatus to become broken or inoperative, or to get out of order.

The two moving parts, the armature and valve closing member, move together and comprise a unit. There are no other moving parts in the apparatus, saving the cycle determinator 34 and the switch 38. The apparatus, therefore, is simple, inexpensive to build, and possesses a long life.

What is claimed as new and is desired to be secured by Letters Patent of the United States is:

1. A refrigerating device comprising upper and lower tanks, a conduit therebetween, a breather for the upper of said tanks, a container for a sublimable refrigerant in heat transfer relationship with the lower of said tanks, and means connected to said container for periodically directing the sublimate from such refrigerant into said lower tank.

2. In a refrigerating device, upper and lower tanks, a conduit therebetween, a breather for the upper of said tanks, a container for a sublimable refrigerant, a conduit from said container to the lower of said tanks, valve means in said latter mentioned conduit, and means for periodically opening and closing said valve.

3. The combination with connected tanks for a heat transfer liquid, a container for a sublimable refrigerant, said container having means for periodically emptying its sublimate content into the first of said tanks for forcing such heat transfer liquid out of said tank into the second of said tanks, the second of said tanks having escape means for air and gas.

4. In combination, a container for a sublimable refrigerant, a tank for a heat transfer liquid, means for periodically connecting said container and tank to discharge the sublimate from said container into said tank, and means for recovering the liquid forced out of said tank by such sublimate.

5. In combination, upper and lower tanks for a heat transfer liquid, a conduit between said tanks, a container for a sublimable refrigerant, a conduit between said container and the lower of said tanks, a housing for said lower tank and said container, and an air and gas conduit from the upper tank to said housing.

6. In combination, upper and lower tanks for a heat transfer liquid, a conduit for liquid therebetween, a container for a sublimable refrigerant in heat transfer relationship to the lower of said tanks, a gas conduit between said container and the lower of said tanks, a housing for said lower tank and said container, and an air and gas conduit from the upper tank into said housing.

7. In combination, upper and lower tanks for brine, a brine conduit therebetween, separate housings for said tanks, a breather from the upper tank and opening in the housing for the lower tank, a container for a sublimable refrigerant in the housing for said lower tank, and a gas conduit from said container to said lower tank for discharging the gas collected in said container into said lower tank.

8. In combination, upper and lower brine tanks, a brine conduit therebetween, an enclosing housing for said brine tanks, a breather extending in the upper tank and opening into the housing for said lower tank, a container for a sublimable refrigerant in the housing for said lower tank, said container being in heat transfer relationship to said lower tank, a gas conduit from said container to said lower tank for discharging gas collected in said container into said lower tank, and a valve in said gas conduit for periodically releasing the gas collected in said container directly into the housing for said lower tank.

9. In combination, upper and lower tanks for brine or the like, a brine conduit therebetween, enclosing housings for said tanks, a container for a sublimable refrigerant in the housing for said lower tank and in heat transfer relationship with said tank, a gas conduit from said container to said lower tank, a valve in said conduit for releasing gas collected in said container into the housing for said lower tank, a breather for said upper tank also emptying into said housing for said lower tank, and valve means in said lower tank for the escape of excess gas from the housing for said lower tank.

10. In combination, upper and lower tanks for a heat transfer liquid, a conduit between said tanks, a container for a sublimable refrigerant in heat transfer relationship with the lower of said tanks, a gas conduit between said container and said lower tank, a valve in said gas conduit, and periodically actuated valve closing means operably connected with said valve.

11. In combination, upper and lower brine tanks, a conduit between said tanks, a breather extending from the upper of said tanks, the capacity of said upper tank being greater than that of the lower tank, a container for a sublimable refrigerant in heat transfer relationship to the lower of said tanks, a gas conduit between said container and said lower tank, a valve in said conduit, and means actuated at predetermined intervals of time independent of temperature conditions in said tank for opening and closing said valve.

12. In combination, upper and lower tanks for brine, a conduit between said tanks, a breather for the upper tank, a container for a sublimable refrigerant in heat transfer relationship to the lower of said tanks, a gas conduit between said container and the lower of said tanks, a valve in said conduit, means operable independent of temperature conditions in said tanks and container for opening and closing said valve at predetermined intervals of time, and means controlled by the temperature about one of said tanks for rendering said valve opening and closing means inoperable.

13. In combination, upper and lower brine tanks, a conduit therebetween, insulating housings for said tanks, a container for a sublimable refrigerant in the housing for the lower of said tanks, a breather from the upper of said tanks to the housing for the lower of said tanks, a gas conduit between the container for the refrigerant and the lower of said tanks, a valve in said gas conduit, periodically actuated means for opening and closing said valve, the actuation of said means being independent of the temperature of said tanks, container, and compartments, and a means for rendering said periodically actuated means inoperable, said latter means being controlled by the temperature within one of said housings.

14. In combination, upper and lower tanks for brine, a conduit therebetween, housings for said tanks, a container for a sublimable refrigerant in heat transfer relation with the lower of said tanks and contained in the housing for said lower tank, a gas conduit from said container to the lower of said tanks, a valve in said conduit, said valve when opened freeing the gaseous content of said container into the housing for said lower tank, a breather for the upper of said tanks and also opening into the housing for said lower tank, means for closing and opening said valve each for a predetermined period of time, said opening and closing means being operable independently of the temperature of the brine in said tanks, the temperature in said container and the temperature in said housings, and a thermostatically controlled means in the housing for the upper of said tanks for rendering said valve opening and closing means inoperative.

15. In combination, upper and lower tanks for brine, a conduit between said tanks, housings for said tanks, a breather for the upper of said tanks, a container for a sublimable refrigerant in the housing of the lower of said tanks, a conduit from the said container to said lower tank, a valve in said conduit, a solenoid for actuating said valve, means for periodically energizing said solenoid, and a thermostatically controlled switch in the housing for the upper of said tanks, said switch being operable to open the circuit to said solenoid when a predetermined level of temperature has been obtained in said housing for the upper of said tanks.

16. A refrigerating device comprising upper and lower tanks, a conduit therebetween, heat

transfer liquid normally in the lower of said tanks, a breather for the upper of said tanks, a container for a sublimable refrigerant in heat transfer relationship with the lower of said tanks, a sublimating refrigerant in said container adapted to produce a gas pressure higher than atmospheric, and means for periodically exerting the gas pressure of said sublimating refrigerant upon the heat transfer liquid in said lower tank causing the said heat transfer liquid to rise to said upper tank.

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